Space Weather Technical Forecast

Issued on Friday, 15 March 2024 at 13:05 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance of M-flares (R1/R2 Radio Blackouts). Chance of reaching S1/Minor Radiation Storm mainly Day 1 (15 Mar).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low, with a long period C5.9 flare peaking at 15/0610 UTC from ex-3599 over the west limb. There are now four sunspot regions on the visible disc, with AR3606 having faded. All regions are currently small and simple, with AR3607 starting to fade.
The long period C5.9 flare produced a CME directed towards the southwest. Given the location any interaction at Earth is likely to be mostly shock, however assessment of this event is ongoing.

Solar Wind / Geomagnetic Activity: Solar wind speeds observed at L1 by ACE showed signs of a very weak high speed stream (HSS), likely from CH09/+. Wind speeds have been mostly slightly elevated, varying between 370-480 km/s. The density was mostly below average. The Interplanetary Magnetic Field, Bt, was initially moderate around 8nT, but declined to become weak. The north-south component, Bz, varied mostly weakly between +8/-7nT. The phi angle was mostly positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 1-3).

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux was initially at background levels, but rose slightly after the C5.9 flare, reaching a maximum of 5pfu at 15/1225 UTC, below the S1/Minor Radiation storm threshold.
High energy electron flux (greater than 2MeV) observed at GOES16 was at background levels. The observed 24-hour fluence was steady below the Active threshold, with the value at 15/0000 UTC being 3.82e6 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: There is a slight chance of M-class flares, most likely from Ex-3599 on Day 1 (15 Mar). A potential returning region rotating onto the disc late Day 2 or Day 3 (16-17 Mar) contributes to a slight increase in flare risk later in the period, but this is low confidence.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are in the current forecast. However, the CME associated with the long period C5.9 flare this morning is still undergoing analysis. Given the location any interaction at Earth, potentially on Days 2-3 (16-17 Mar) is likely to be mostly shock, however assessment of this event is ongoing. Confidence in the solar wind forecast is relatively low. Several coronal holes are in the forecast, with the potential for weak fast winds, but none are thought likely to give significant impacts at Earth.
Mostly Quiet or Unsettled (Kp 0-3) conditions are expected over the period, with a chance of an Active (Kp 4) interval should a stronger connection to the CH10/- HSS or any CME influence occur, mainly on Days 2-3.

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) is currently slightly elevated after the long period C5.9 flare this morning, with a chance of reaching the S1/Minor Radiation storm threshold. Ex-3599 rotates well away from the west limb during the

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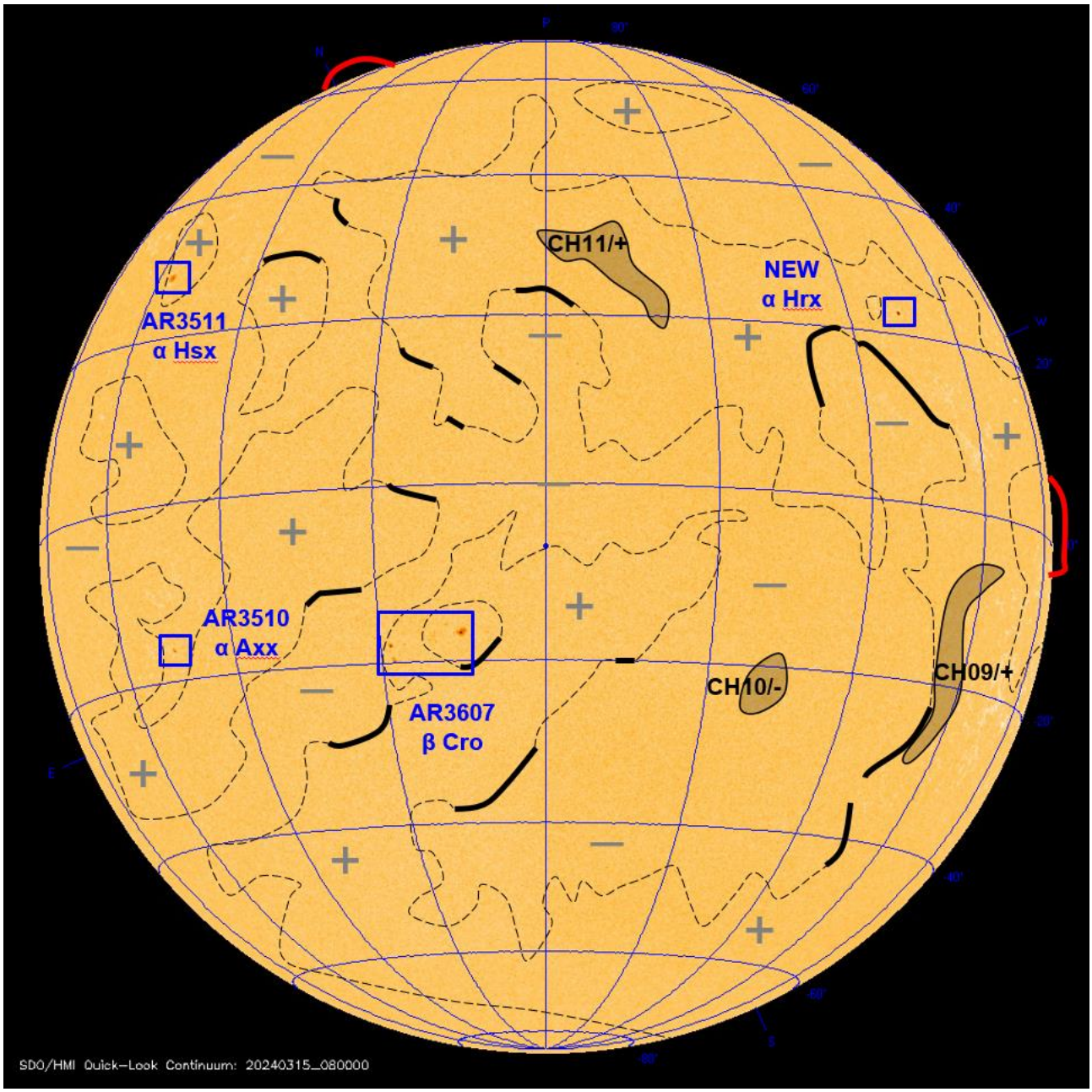
period, with a corresponding decline in probability of reaching S1.
High energy electron flux (greater than 2MeV) is currently at background levels and expected to stay that way. 24-hr integrated fluence is likely to remain below the Active threshold throughout.

Figure 1. Solar Analysis Valid 15/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The CME associated with the long period C5.9 flare this morning from ex-3599 over the west limb is still undergoing analysis. Given the location of the eruption any interaction at Earth, potentially on Days 2-3 (16-17 Mar), is likely to be mostly shock, however assessment of this event is ongoing.

Confidence in the solar wind forecast is relatively low, with only minimal persistence of coronal hole features when compared to the previous rotation. The slightly elevated winds currently observed are thought to emanate from a weak, but waning, connection to a high speed stream from CH09/+. The small negative polarity coronal hole, CH10/- will rotate into a more geoeffective position during Days 2-3 (16-17 Mar), however it is such a small feature that any HSS from this is unlikely to give significant impacts at Earth. We also have CH11/+ in the northern hemisphere, which was present on the previous rotation, but gave little impact at Earth and similar is expected this time around.
Mostly Quiet or Unsettled (Kp 0-3) conditions are expected over the period, with a chance of an Active (Kp 4) interval should a stronger connection to the CH10/- HSS or any CME influence occur, mainly on Days 2-3.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	5	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Assessment of CME from the long period flare this morning is ongoing.

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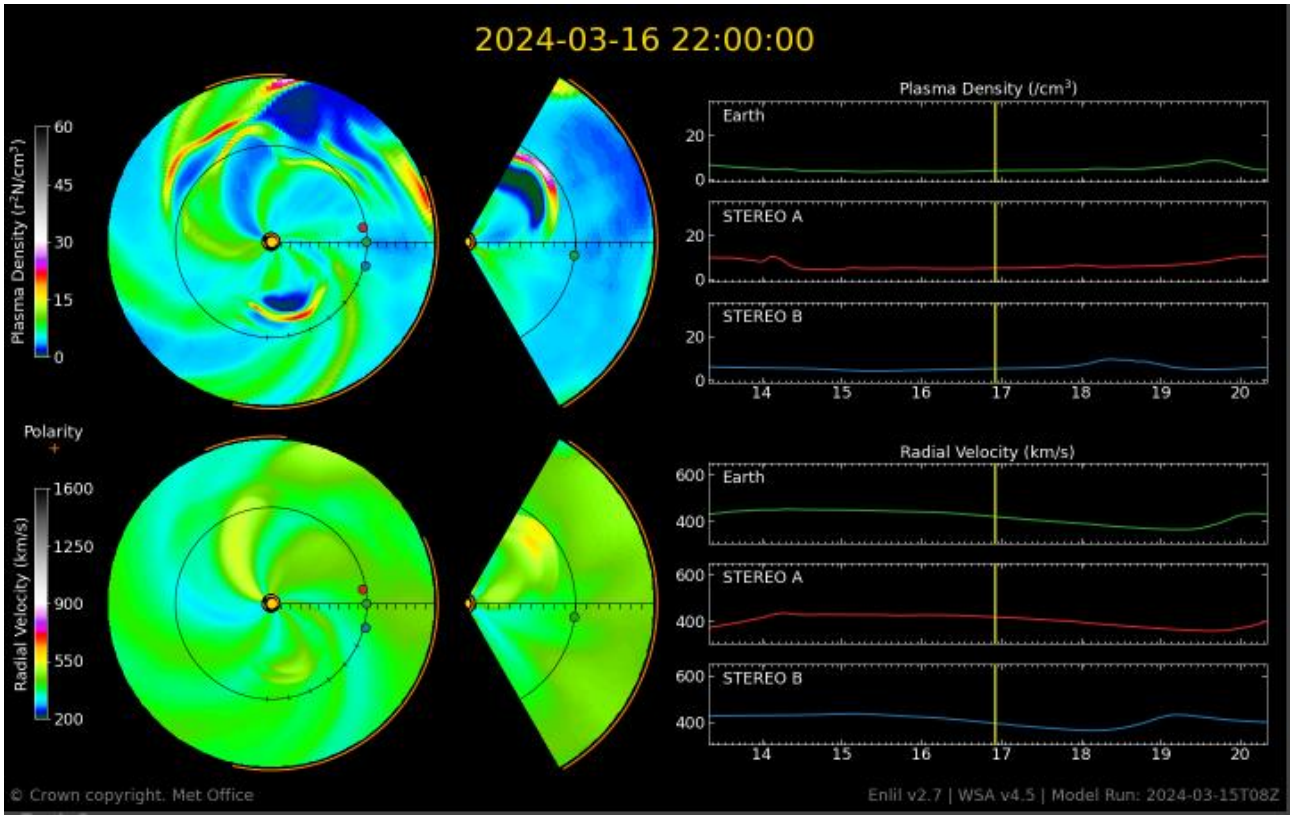
Figure 2: MOSWOC Enlil, which doesn't currently show the CME from this morning.



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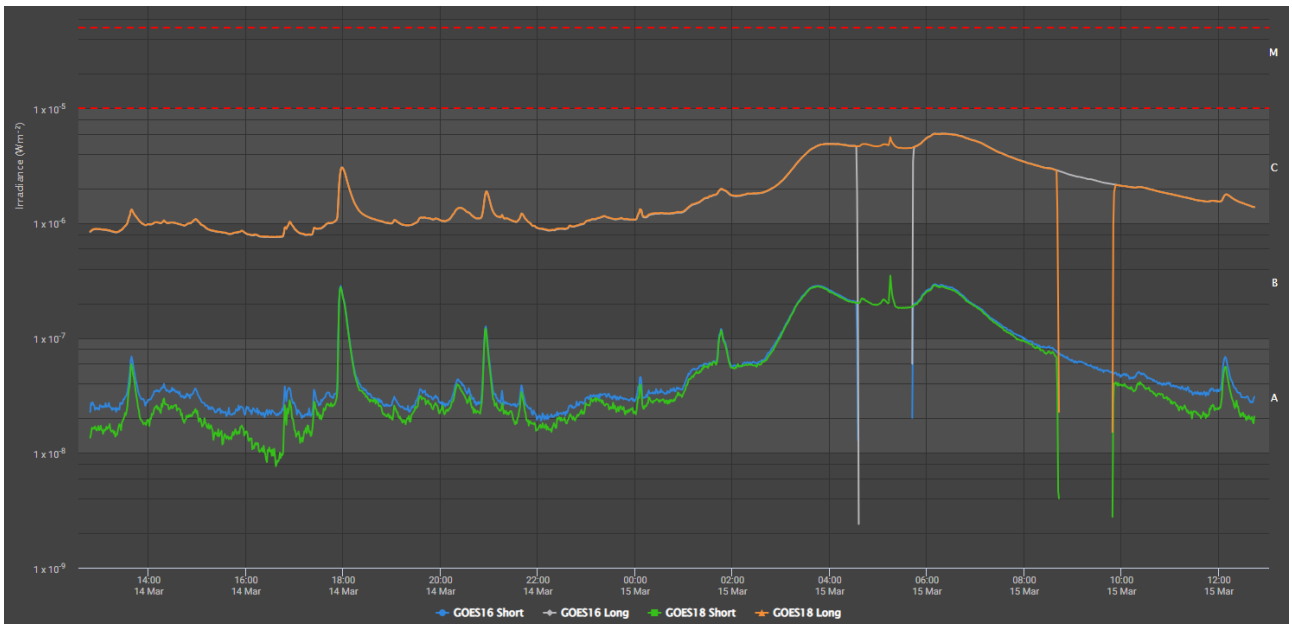
Radio Blackouts - X-Ray Flares:
Solar activity has been Low, with a long period C5.9 flare peaking at 15/0610 UTC from ex-3599 over the west limb. There are now four sunspot regions on the visible disc, with AR3606 having faded. All regions are currently small and simple, with AR3607 starting to fade.

Ex-3599 continues to contribute a declining amount to the X-ray flare forecast through Day 1 (15 Mar) before it rotates sufficiently beyond the western limb to lose influence. Helioseismology suggests that a larger region is projected to rotate onto the disc probably later on Day 2 or into Day 3 (16-17 Mar); this may be ex-3590, which was the source of several Strong flares on the previous rotation. The return of this region is reflected by the slight increase in flare probabilities later in the period, however confidence in this is low until the region rotates onto the disc and can be assessed.

Activity is expected to remain Low with a slight chance of becoming Moderate, should any isolated M-class flares occur, most likely from ex-3599 at first, then from the potential ex-3590 later in the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	15	10	20	20
Very Active	R3 to R5 X Class	No	1	1	5	5

Figure 3: X-ray trace at GOES16 and 18, showing the long period C-flare from ex-3599 over the limb.



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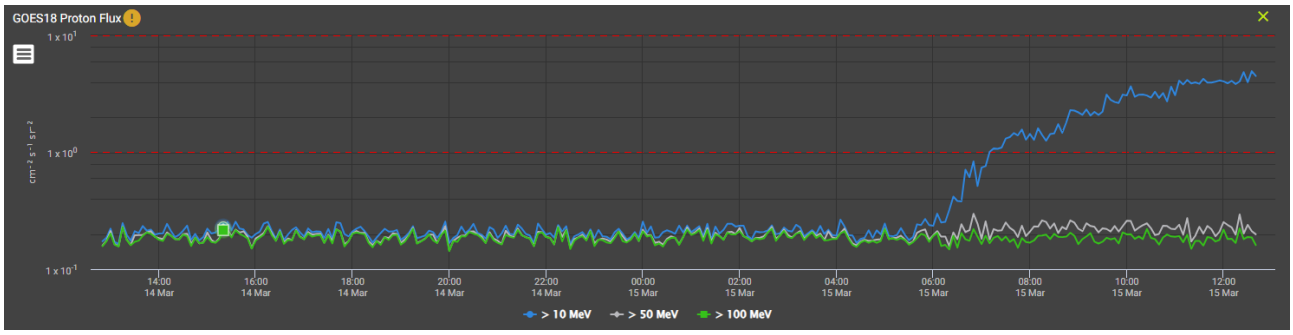
Solar Radiation Storms - (High Energy Protons):
Proton flux at GOES18 has increased somewhat in response to the long period C5.9 flare earlier this morning from ex-3599 over the west limb. Whilst the flux is currently below the S1/Minor Radiation storm threshold, there is a chance that it may exceed if flux continues to gradually rise, or if there is another flare from this region. The risk of further proton events from this region remains until it reaches around W120-130 later on Day 2 (16 Mar), with a decline in probability thereafter.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	25	20	10	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: 10MeV proton flux at GOES18, showing the rise in flux over the last few hours, but below the S1/Minor Radiation storm threshold.



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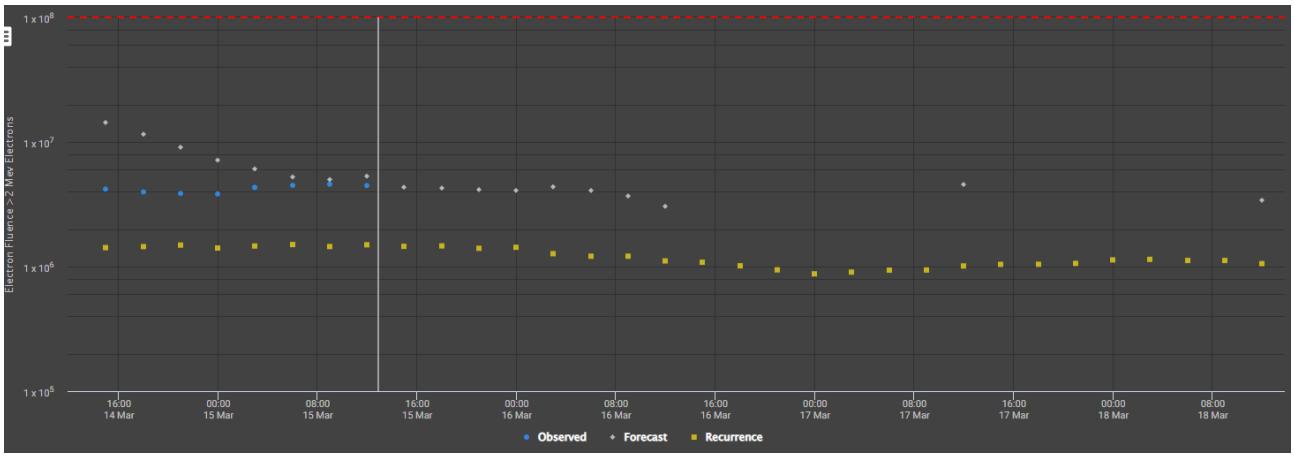
High Energy Electrons Event (≥ 2MeV):
Over recent days the high energy electron flux (greater than 2MeV) has shown a decreasing trend and is now near background levels. Given the absence of any significant enhancement in the forecast, this is expected to continue.

The associated 24-hr integrated fluence is expected to remain well below the Active threshold throughout, which is supported by MOSWOC REFM.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	No	1	1	1	1
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC Enlil, showing a below Active forecast.



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